METHOD FOR CONTROLLING STARTING OPERATION OF UNIT AND EXECUTING SELF-CHECKING TEST

BACKGROUND OF THE INVENTION

1. Technical Field:

The present invention relates to a method for controlling starting operation of a unit, a method for executing a self-checking test of a unit, a control board, a device, and a checking system which are suitable for fabricating a wide variety of units.

2. Description of the Related Art:

A great variety of devices now include a mechanical part, having moving parts, and a circuit section (circuit board) for driving the moving parts. Examples include a tape drive unit, a hard-disk unit, a printer, and other similar units. After power is applied to the unit at start up, these units enter a usable state after self-checking tests, such as initialization and test of the circuit section, operational test of the structural portion, and other tests have been executed. Such self-checking tests are executed based on a program stored in the read-only memory (ROM) of the circuit section.

In the process of fabricating the aforementioned units, predetermined tests are also given at predetermined points in the course of the fabricating process. The predetermined tests include, for example, a test of a single component and a test of a unit made up of a plurality of components (e.g., a test of a single circuit board and a test of a circuit board and a mechanical part combined with each other, respectively) and further include a test of a finished product.

It is possible to execute these tests by use of a dedicated test program from an external testing system after the completion of a single circuit board. It is also possible to execute the tests from a program stored in the circuit board itself (e.g., in the ROM of the circuit board).

The aforementioned self-checking test is normally executed during user operation of a unit in a finished-product state (hereinafter referred to as "normal operating mode"), and the tests employed in the course of the fabricating process will, if stored in ROM, represent unnecessary testing content that is not useful when the product is completed. If there is unnecessary test content, the tests will necessarily take time, resulting in a reduction in efficiency.

The present invention has been achieved in view of the aforementioned points. Accordingly, it is a primary object of the present invention to provide a method for controlling starting operation of a unit, a method for executing a self-checking test of a unit, a control board, a device, and a checking system which are capable of enhancing production efficiency in the fabricating process.

SUMMARY OF THE INVENTION

To solve the aforementioned problems, a dedicated program for executing a test during the fabricating process can be prepared and stored in a circuit board.

In this method, however, it is necessary to prepare multiple types of programs in accordance with each step of executing a test, complicating maintenance. In addition, after predetermined tests and processes are completed, it is necessary to rewrite the test mode program to accommodate the normal operating mode. If rewriting is forgotten, finished products with the pre-completion test mode program will be shipped.

Another potential solution involves storing the normal operating mode program and the test mode program in the circuit board with a dip switch for varying the mode. If the dip switch is set to test mode in the fabricating process, the test mode program is executed when the unit is activated, and predetermined tests can be executed.

In the dip switch method, it is possible to easily change modes by switching the dip switch. However, if, after completion of all tests and processes, switching the dip switch to the normal operating mode is forgotten and the unit is shipped, the test program will be executed in booting the unit after shipment. In addition, the dip switch is required merely for the purpose of executing tests in the fabricating process and therefore represents needless expense.

Instead of employing the aforementioned dip switch, a setting flag for executing the normal operating mode program and a setting flag for executing the test mode program can also be stored in an arbitrary region within non-volatile memory provided in the circuit board. This region will hereinafter be referred to as a vital product data (VPD) region. In the fabricating process, the test mode program can be executed at start up by switching the setting.

Such a method allows prevention of shipment of finished products set to boot in test mode because it is possible to assemble into a sequence of tests a process that sets a flag to the normal operating mode. However, it is necessary to boot a program and expend time in order to vary the setting of the flag. This method has not effectively achieved the object of the present invention, i.e., enhancing production efficiency in the fabricating process.

To attain the aforementioned object of the present invention, there is provided a method for controlling starting operation of a unit having at least a circuit portion, comprising the steps of:

executing a first self-checking test when a connection between an outside device and the circuit portion is not recognized; and

executing a second self-checking test including at least part of the first self-checking test, when the connection between the outside device and the circuit portion is recognized.

The method of controlling starting operation of a unit is effective when applied to units in which a self-checking test of each part such as a circuit, a mechanical part, or another system component is executed at start up. The "unit" used herein does not always need to be a unit in a finished-product state. It means a single circuit section, a combination of a circuit section and a mechanical part, or any other suitable configuration.

Where an outside device (to be employed in the fabricating process) has not been connected, the unit will start up, and the program stored in the circuit section will boot, in a finished-product state (ready for shipment). The first self-checking test will then be executed, and each part of the unit will be checked.

On the other hand, when making a predetermined check or an adjustment in the process of fabricating such a unit, or when analyzing failure, the self-checking test is also executed at the time when the unit has been started up and a process based on the program stored in the circuit section has been started. In such a case, the circuit section of the unit is connected with an outside device that is employed in a check, adjustment, or failure analysis. The unit in this stage is started up and recognizes that the aforementioned outside device has been connected. The second self-checking test, which includes only a portion of the tests in the first self-checking test (to be executed in a finished-product state) is executed. For instance, in the case where a check of only the circuit portion (only a board) is made in the fabricating process, sections other than the circuit section (board) may not have been assembled and may not require testing. This allows that a self-checking test of only the circuit section (board) may be adequate. Likewise, in the self-checking test prior to making an adjustment to the mechanical part of a unit in the fabricating process, self-checking tests of only the minimum elements (circuits or elements) required for operating the mechanical part may be adequate. There may be no necessity for executing self-checking tests of the entire circuit section. Thus, in the fabricating process, the minimum of the self-checking tests required should be executed when a program is booted, whereby the time required for the self-checking tests can be shortened. After the required minimum self-checking tests are executed, other predetermined operations, such as initialization of the circuit section in the fabricating process (e.g., writing of a serial number, etc.), adjustments to each part, setting of controls, and other operations are executed.

It is preferable that, at the time of recognizing a connection to an outside device, a predetermined command be transmitted from the unit and whether there is input of a control command output from the outside device in response to the predetermined command be detected. The predetermined command and the control command may be input or output between the outside device and the circuit portion through an interface.

In accordance with the present invention, there is also provided a method for executing a self-checking test of a unit equipped with a mechanical part for performing a predetermined operation and a control board for controlling the mechanical part, comprising:

a first step of executing a test common to a first self-checking test, which is executed when the unit is in a finished-product state, and a second self-checking test, which is executed when the unit is in an unfinished-product state;

a second step of judging whether or not the unit is in the finished-product state; and

a third step of continuing either the first self-checking test, which is executed when the unit is in a finished-product state, or the second self-checking test, which is executed when the unit is in an unfinished-product state, based on the result of judgement in the second step.

The second self-checking test, which is executed when the unit is in an unfinished-product state, is characterized by further comprising a fourth step of overwriting a flag-setting of a program in accordance with a next self-checking test. Therefore, at the time of executing the next self-checking test, a predetermined process is executed according to the set flag. For example, test during the process of fabricating a unit requires that the first through the third steps of the second self-checking test, which is executed when the unit is in an unfinished-product state, are executed. In the fourth step, the set flag is overwritten so that in the next test, the self-checking test in a finished-product state is executed. If done in this manner, the self-checking test in a finished-product state is executed when this unit is started up after shipment. In addition, where a plurality of processes in fabricating a unit exists, execution of a self-checking test in an unfinished state may overwrite a set flag in accordance with the next

self-checking test.

Thus, the flag overwriting process is executed as part of the self-checking test, which is executed when a unit is in an unfinished-product state, and human errors, such as forgetting to change a setting, can be avoided.

In accordance with the present invention, a control board is also provided, which is combined with a mechanical part for performing a predetermined operation. It stores a program for controlling the mechanical part, which is characterized by including a process for transmitting a predetermined command to the outside device through an interface and a process of selecting and executing a specific self-checking test program from several kinds of self-checking test programs in accordance with a control command input from the outside device through the interface in response to the predetermined command. Furthermore, the program is characterized in that a specific self-checking test program may be selected based on whether or not a predetermined flag has been set by a control command output from the outside device. When the flag has been set, the specific self-checking test program may be selected based on the type of flag.

In addition, by employing an input-output port as an interface for debugging a program, there is no need to provide a special interface for output of said predetermined command and input of a control command. An interface other than the input-output port for debugging may also be utilized.

In accordance with the present invention, there is also provided a unit comprising a mechanical part for performing a predetermined operation and a control section for controlling the mechanical part, in which the control section comprises:

storage means for storing several kinds of self-checking test programs, which are executed at the time of starting an operation;

notification means for informing an outside device at predetermined time, that a command is acceptable;

selection means for selecting a self-checking test program, which is executed from among multiple types of self-checking test programs, based on whether or not there is a control command input from the outside device in response to the notification by the notification means; and

execution means for executing the self-checking test programs selected by the selection means.

The present invention applies to a variety of drives, including a tape drive unit, a hard-disk drive unit, a compact-disk drive unit, a printer, a video cassette deck, a video camera, a copying unit, a facsimile unit, and many other, similar devices.

In accordance with the present invention, there is provided a system for checking a product, which is equipped with a moving part and a control section for controlling the moving part, in a process of fabricating the product, in which a command for shifting the checking system to a predetermined self-checking test is output with the checking system connected to the product equipped with at least the control section, when it is notified by the product that a command is acceptable.

And in this checking system, a predetermined check is made for the product given a predetermined self-checking test in response to the command output from the checking system.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a block diagram showing the configuration of a tape drive unit, which becomes a testing object in a method for controlling starting operation of a unit and for executing a self-checking test of a unit, according to an embodiment of the present invention;

Figure 2 is a diagram showing the flow of a self-checking testing method for the tape drive unit;

Figure 3 is a diagram showing the flow of the process of a self-checking testing method in a normal operating mode;

Figure 4 is a diagram showing the configuration of a testing system for executing a test to a single circuit board;

Figure 5 is a diagram showing the flow of the process of testing the single circuit board;

Figure 6 is a diagram showing the configuration of a testing system employed in a box assembling process;

Figure 7 is a diagram showing a test of a box assembling process and the flow of a fine adjustment;

Figure 8 is a diagram showing a tape head to which fine adjustments are made in the box assembling process; **Figure 8A** is a front view showing the tape head and **Figure 8B** is a plan view of the tape head;

Figure 9 is a diagram showing a tape drive unit connected to a testing system which is employed in a box test; and

Figure 10 is a diagram showing flow of a box testing process.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention will hereinafter be described in detail, based on an embodiment shown in the accompanying drawings.

Figure 1 is a diagram for explaining a tape drive unit that becomes a testing object in a method for controlling starting operation of a unit and executing a self-checking test of a unit, according to an embodiment of the present invention. In the drawing, reference numeral **1** denotes a tape drive unit, which is a unit, an item of equipment, or a product. Reference numeral **10** denotes a mechanical part (moving part) of the tape drive unit **1**. Reference numeral **20** denotes a circuit board (card), which is configured by the circuit section, the control board, and the control section of the tape drive unit **1**.

As the mechanical part **10**, there is a tape head **11**, which abuts the tape **T** of a tape cartridge (storage medium) mounted in the tape drive unit **1** to perform read and write operations on the tape **T**, a head drive mechanism (not shown) for moving the tape **T** away from or toward this tape head **11**, a motor (not shown) for driving a pair of reels (in-reel and out-reel) **12** for winding up the tape **T**, an ink jet mechanism (not shown) for discharging the tape cartridge, and other related equipment.

The circuit board **20** is equipped with a CPU (selection means, execution means) **21** for controlling the unit. It also contains a read-only memory (ROM) **22** as storage means for storing a predetermined program for reading or writing data from or to the tape **T** of the tape cartridge in the tape drive unit **1** and a memory **23** such as a random access memory (RAM). An electrically erasable and programmable read-only memory (EEPROM) **24**, which is non-volatile memory, is also present for storing information required for booting the system. The system also contains a motor control block **25** for

controlling a motor (not shown) and a servo channel block **26** for controlling the tape head **11**. System components involved in the transfer of data include a data channel block **27** for controlling reading and writing of data at the tape head **11** and generating data in a predetermined form and a small computer system interface (SCSI) control block **28** for controlling input and output between the data to be handled by the data channel block **27** and an outside device.

The circuit board **20** is equipped with an input-output port or debug port (interface, notification means) **30** that is employed at the time of debugging the computer program. This input-output port **30** is connected directly to the CPU **21** and is an interface capable of bi-directional data transfer, such as a serial port or a parallel port.

The tape drive unit **1** is connected with other pieces of equipment and is equipped with a SCSI bus (interface, notification means) **40** for transmitting or receiving data through the SCSI control block **28** of the circuit board **20**.

The programs stored in the ROM **22** include a program for executing a self-checking test at the time of booting the system (or the time of applying power to the system). **Figure 2** shows a high-level flow of the self-checking test program.

As shown in this drawing, if the system is booted, the basic modules on the circuit board **20** are initialized, and after they have been set to an operable state (step **S11**), an operational test for the basic modules is carried out (step **S12**). The basic modules used herein include the CPU **21**, the ROM **22**, and the memory **23**. In this embodiment, the setting of the CPU **21** is performed during the initialization of basic modules in step **S11**. Following this, the test of the basic modules in step **S12** is executed as follows. Sensors (not shown) mounted on the circuit board **20** are checked to confirm whether or not the voltage being applied to the tape drive unit **1** (circuit board

20) and the temperature of the unit **1** are within allowable ranges, whether or not the program written to the ROM **22** is correct, whether or not data can be correctly read or written from or to the memory **23**, and other tests of similar type.

Next, the constituent modules of the circuit board **20** are initialized and set to an operable state (step **S13**). The constituent modules used herein are the tape head **11**, the EEPROM **24**, the motor control block **25**, the servo channel block **26**, the data channel block **27**, the SCSI control block **28**, and the input-output port **30**. More specifically, in the initialization of the constituent modules in step **S13**, confirmation of whether each register of the constituent modules is in a usable state, confirmation of whether connector lines for the SCSI bus **40** have been connected correctly, and confirmation of whether a predetermined interrupt process is correctly performed when an interrupt signal is input to the CPU **21**, are performed after the program stored in the ROM **22** is expanded to the memory **23**.

The next step **S14** checks whether or not a flag has been set to a vital product data (VPD) region in the EEPROM **24**. When the flag has been set, the process skips to step **S20,** which will be described later. When the flag has not been set to the VPD region in the EEPROM **24**, the input-output port **30** is subsequently set to an operable state so that it can accept a debug command (step **S15**). The input-output port **30** then signals, by a predetermined command, such as a predetermined character string, that it can accept the debug command from the CPU **21** (step **S16**).

After this, the input-output port **30** waits for external command input for a predetermined time (e.g., about 1 sec) (step **S17**).

Although described in detail later, nothing is normally connected to the input-output port **30** when the tape drive unit **1** is in a finished-product state (after shipment). There is also no external command input.

On the other hand, in the test step during fabrication of the tape drive unit **1**, testing systems (external equipment, checking systems) **200**, **300**, and **400** (to be described later) are connected to the input-output port **30** or the SCSI bus **40**. When receiving a character string output from the input-output port **30** or SCSI bus **40**, the testing systems **200**, **300**, and **400** provide control commands for shifting to predetermined test modes, which differ for each step (step **S30**). The control commands are received from the input-output port **30** to the tape drive unit **1** (circuit board **20**). If the character string of the control command from an outside device is detected during step **S17**, the circuit board **20** receives a flag representing a command to enter the test mode through an interrupt routine and temporarily stores the flag in the memory **23**.

Efficiency favors executing both the self-checking test for normal operating mode in a finished-product state and the common, preliminary tests at each step during fabrication, while waiting for command input, in step **S17**.

Subsequently, after checking the input command (step **S18**), whether or not a flag to enter a test mode has been set (step **S19**) is detected.

Here, when the flag has not been set, there is no control command from the outside systems (testing systems **200**, **300**, and **400**), and no testing systems **200**, **300**, and **400** are connected to the input-output ports **30**. That is, the tape drive unit **1** is judged to be in a finished-product state, and a test for a normal operating mode (normal operation) is executed (step **S100**).

On the other hand, when the flag has been set, the contents are analyzed (step **S20**). According to the result, the process in this embodiment shifts to a card test mode, a box assembling process mode, or a box test mode and carries out settings and operations corresponding to the appropriate mode (steps **S200**, **S300**, and **S400**).

A description of the test mode at each mode branched in the above-mentioned steps **S19** and **S20** will be given now.

Shown in **Figure 3** is flow of self-checking tests at the normal operating mode in the aforementioned step **S100**.

In step **S101**, the test of the motor (not shown) of the mechanical part **10** is executed. In this test, the motor is actually operated. Then, whether it operates correctly, and whether each sensor controlling the motor operates correctly is confirmed. Note that this motor test takes more than 60 seconds.

In step **S102**, it is confirmed that the magnetic resistance value of a magneto-resistive head, which is the tape head **11**, is within a predetermined range.

In the data long LWR test in step **S103** it is confirmed, within the data channel block **27**, that data can be correctly transferred to the side of the tape head **11**.

In step **S104**, in the servo channel block **26** and motor control block **25**, a pseudo test for rotating the motor (servo LWR test) is executed by confirming that servo patterns can be correctly transferred and interpreted.

With the aforementioned steps, the self-checking test of the normal operating mode ends, whereby the tape drive unit **1** achieves an operable state.

A sequence of self-checking tests in steps **S11** to **S13**, **S17**, and step **S100** (first self-checking test) are executed when the unit **1** is in a finished-product state (e.g., at start up). This sequence of self-checking tests is called a power-on self-test (POST).

Figure 4 shows the testing system **200** when a test is given to the single circuit board **20** during the process of fabricating the tape drive unit **1**. This testing system **200** connects a connector with the input-output port **30** of the circuit board **20** so that data can be transferred there between.

In the circuit board **20**, with the input-output port **30** connected with the testing system **200**, a flag has not been set to the VPD region in the EEPROM **24**, so the process advances from step **S14** in **Figure 2** to step **S15**. In the following step **S16**, if it is determined that a debug command is receivable through the input-output port **30**, a card-test control command is issued in step **S30** from the testing system. The control command is sent from the input-output port **30** to the circuit board **20**, whereby the process shifts to the test of the single circuit board **20** in step **S200**.

Figure 5 specifically shows flow of the test (step **S200**) of the single circuit board **20** executed by the testing system **200**.

In the single circuit board state **20**, a flag has not been set to the VPD region in the EEPROM **24**. Therefore, the EEPROM **24** is tested (step **S201**). The EEPROM **24** is non-volatile memory and therefore, no test is executed in the self-checking test in the normal operating mode. Thus, only the EEPROM test is executed at this time.

The VPD region is initialized next, so that information required for booting the system, is written (step **S202**). Also, the test (RS422 wrap test) of an interface (RS422), which is employed when multiple tape drive units **1** are combined into a library unit, is

executed (step **S203**).

Thereafter, as with steps **S103** and **S104** in the normal operating mode, the data long LWR test and the servo LWR test are executed (steps **S204**, **S205**). The booting of the circuit board **20** in the card test process is then complete (step **S206**).

In step **S207** the circuit board **20** is actually tested by a predetermined program in the testing system **200**. In this embodiment, the operation of each of the individual functional blocks constituting the circuit board **20** is checked by testing system **200** shown in **Figure 4** through use of a head emulation unit **110**, a motor circuit test unit **120**, a tape cartridge **130**, and other equipment. In the head emulation unit **110**, the data channel block **27**, and other related parts are tested in a manner that simulates data being read out or written in with the tape head **11** (which has not been assembled at this point of time). This is accomplished through use of a waveform generator **111** and an oscilloscope **112**. Also, in the motor circuit test unit **120**, a loader motor **121** of the same type as the mechanical part **10** (which has not been assembled at this point of time), a reel motor **122**, a stepper motor **123**, and a voice coil motor **124** are actually connected to the motor control block **25**, and a circuit test is executed. In the tape cartridge **130**, instead of employing a tape cartridge that will be added later, a memory cartridge **131**, in which predetermined data has previously been stored at a predetermined position, is employed to determine whether or not data can be read out or written in.

Settings, such as a serial number, specific to the individual circuit boards **20**, are performed to track the shipment quality of the circuit board **20**. Because settings for the box assembling process are made at the end of the test of the circuit board **20**, a flag for the VPD region in the EEPROM **24** is written (step **S208**).

In the above-mentioned way, in the test of the single circuit board **20** in an unfinished-product state, a sequence of self-checking tests (second power-on self-test) in steps **S11** to **S13**, step **S17**, and step **S200** are executed, and part of the power-on self-test (POST) in the normal operating mode is executed. Also, in the test of this single circuit board **20**, in steps **S201**, **S202**, **S207**, and **S208**, other predetermined operations different from the power-on self-test (POST) in the normal operating mode are executed.

In such a test of the single circuit board **20**, the motor test (step **S101**) and the MR head resistance test (step **S102**), which are executed by actually operating the mechanical part **10**, are not executed. This is different from the normal operating mode. Although it takes, in the normal operating mode, about 103.9 sec to complete booting (step **S11** to step **S100**), the test of the single circuit board **20** takes about 39.1 sec to complete booting from step **S11** to step **S206**. This result saves time.

Figure 6 shows the testing system **300** when, in the process of fabricating the tape drive unit **1**, a test is executed with the mechanical part **1** mounted on the circuit board **20**. This testing system **300** connects a connector to the input-output port **30** of the circuit board **20**, allowing for the transfer of data between them.

In the circuit board **20** with the input-output port **30** connected with the testing system **300**, the process skips from step **S14** of **Figure 2** to step **S20**, because a flag has been written to the VPD region in the EEPROM **24** in step **S208**. The process shifts to the box-assembling process test in step **S300**, in compliance with the written flag.

Figure 7 shows the flow of the test at the box-assembling process in greater detail.

The box assembling process involves a test (step **S300**) at the stage of making fine adjustments to the tape head **11** with the mechanical part **10** assembled to the circuit board **20**. Booting is completed (step **S301**) after, in steps **S19** and **S20** of **Figure 2**, the flag for the VPD region in the EEPROM **24** is checked. The checking in this process can be made within about 25.9 sec until completion of booting, by executing the minimum test from step **S11** to step **S13**.

The above-mentioned manner allows that, in the tape drive unit **1** in its unfinished-product state, the minimum self-checking test (second power-on self-test) in steps **S11** to **S13** and step **S300** is executed at the time of starting operation, and then fine adjustments to the tape head **11** are made (step **S302**). Adjustments can include an adjustment of the tape head **11** of the mechanical part **10** to an offset angle **q** (see **Figure 8A**) relative to a direction perpendicular to the running direction of the tape **T**, an adjustment to a stroke (see **Figure 8B**) in the direction where guide rollers **11L**, **11L'** are moved toward and away from the tape **T**, and other similar adjustments.

As shown in **Figure 9**, the testing system **400** is employed in the box test that is executed as an inspection before shipment, with the tape drive unit **1** finished in the fabricating process. The testing system **400** connects a connector to the SCSI bus **40** so that data is transferred and received there between. Efficiency favors parallel test execution, with a multiple of tape drive units **1** connected in a daisy-chain manner.

Figure 10 shows flow of the box test in detail.

In this box test, since a flag has not been overwritten in the above-mentioned box assembling process (process of making fine adjustments to the tape head **11**), the tape drive unit **1** is booted with the same setting as the box assembling process, and step **S11** of **Figure 2** to step **S14**, and step **S20** are performed. In the setting and operation for the

box test in step **S400**, the data (flag) for the VPD region in the EEOROM **24** is overwritten to data for the normal operating mode by a SCSI command through the SCSI bus **40** (step **S401**).

The tape drive unit **1** is then restarted, and the same tests (POST) as those in normal operation are performed (step **S402**). That is, the initialization of the basic modules in step **S11** of **Figure 2**, the test of the basic modules in step **S12**, the initialization of the constituent modules in step **S13**, the test in step **S17**, and the tests in step **S100** (the motor test in step **S101** of **Figure 3**, the MR head resistance test in step **S102**, the data long LWR test in step **S103**, and the servo LWR test in step **S104**) are performed in sequence.

Thereafter, the information for the VPD region in the EEPROM 24, such as a flag, a serial number, etc., is overwritten via a SCSI command, and the tape drive unit **1** is set to a shipment state (step **S403**).

After the setting, the box test is executed (step **S404**). In this embodiment, the tape drive unit **1** is actually started, and the test (POST) in the normal operating state is executed. Then, a tape media cartridge is actually loaded into the tape drive unit **1**, and a command to read out or write data from or to the tape **T** is output through the SCSI bus **40**. Whether data is correctly read out or written from or to the tape **T** loaded into the tape drive unit **1** is tested. After this test, the tape drive unit **1** is shipped as the finished product.

In the above-mentioned method of controlling starting operation of the tape drive unit **1** and method for executing a self-checking test, the motor test and the MR head resistance test, which are the test of the mechanical part **10**, are omitted, particularly in the card test process in which the test of the single circuit board **20** is executed. In the

box assembling process, the test contents are minimized prior to adjustments to the tape head **11**. Thus, separate from the tests in the normal operating mode executed in a finished-product state, test menus corresponding to the various tests in an unfinished-product state in the fabrication process are made, and the time required for tests can be considerably reduced. In addition, test efficiency can be enhanced, and the efficiency of production of the tape drive unit **1** itself can be enhanced.

As the setting of a flag or other data bit, which corresponds to the tests in the subsequent process, is changed in the test program (steps **S208**, **S401**, and **S403**), human errors, such as forgetting a change in setting, can be avoided.

The testing systems **200**, **300**, and **400**, which are employed in each step in the fabrication process, are connected to the input-output port **30** or SCSI bus **40**, and through this input-output port **30**, a control command to execute a test in the fabrication process is transferred or received. Therefore, if only the testing systems **200**, **300**, and **400** are connected, the process can be automatically shifted to a predetermined test mode. Because this input-output port **30** is originally equipped for debugging the computer program, it is unnecessary to provide an additional component for executing a test on the side of the tape drive unit **1**.

In the aforementioned embodiment, a command can be transmitted from the side of the circuit board **20** (tape drive unit **1**) to the outside at the time of executing the self-checking test in the normal operating mode or the self-checking test for the fabrication process. If so, whether or not a control command has been input from the external testing systems **200**, **300**, and **400** is then determined. That said, the present invention is not limited to such an application, but may employ other methods if one can determine whether the tape drive unit **1** is in a finished-product state, or whether the testing system **200**, **300**, or **400** has been connected.

While the input-output port **30** and the SCSI bus **40** are employed as the interface for connecting the testing system **200**, **300**, or **400**, in any other types of interfaces, (a USB port) may be employed if they are interfaces that can perform bi-directional communication.

Although, in the aforementioned embodiment, three types of tests have been executed as the test for the fabricating process, one type of test, two types of tests, or four or more types of tests may be executed, and the test contents are not limited by the exemplary description provided herein.

In addition, products and devices to be tested are not limited to the tape drive unit **1** described in the aforementioned embodiment. The present invention is also applicable to products and devices in which the self-checking test is executed at the time of starting operation, for example, a wide variety of devices, such as hard-disk units, compact-disk drives, printers, video cassette decks, video cameras, copying units, facsimile units, and other similar devices.

As has been described above, the present invention can enhance not only the efficiency of the self-checking test but also the production efficiency of the unit or device itself.